How to Use This Presentation

- To View the presentation as a slideshow with effects select "View" on the menu bar and click on "Slide Show."

- To advance through the presentation, click the right-arrow key or the space bar.

- From the resources slide, click on any resource to see a presentation for that resource.

- From the Chapter menu screen click on any lesson to go directly to that lesson's presentation.

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Bellringer

Imagine that you are an Earth scientist and can travel wherever you want to on Earth. Name and describe the aspects or features of Earth you would like to study. Where you would go and what you would do?

Write and illustrate your answers in your **science journal.**

Objectives

- **Describe** the four major branches of Earth science.
- **Identify** four examples of Earth science that are linked to other areas of science.

- Earth Science can be divided into four major branches:
- Geology
- Oceanography
- Meteorology
- Astronomy

End Of Slide

Geology—Science that Rocks

- **Geology** is the study of the origin, history, and structure of the Earth and the processes that shape the Earth.

- Most geologists specialize in a particular aspect of the Earth.

- A *volcanologist* is a geologist who studies volcanoes.Make careful observations to answer questions.

End of Slide

Geology—Science that Rocks, *continued*

- A *seismologist* is a geologist that studies earthquakes.
- A *paleontologist* is a geologist who studies fossils.

Oceanography—Water, Water Everywhere

- **Oceanography** is the scientific study of the sea.

- Physical oceanographers are geologists who study the physical features of the ocean.

- Biological oceanographers are geologists who study the plants and animals that live in the ocean.

Oceanography—Water, Water Everywhere, *continued*

- Geological oceanographers are geologists who study and explore the ocean floor.

- Chemical oceanographers are geologist who study the amounts and the distributions of natural and human-made chemicals in the ocean.

Oceanography—Water, Water Everywhere, *continued*

- **Exploring the Ocean Floor** Oceanographers use miniature research submarines to travel far below the surface of the oceans.

Meteorology—It's a Gas!

- **Meteorology** is the scientific study of the Earth's atmosphere, especially in relation to weather and climate.

- **Hurricanes** Today, meteorologists warn people about hurricanes, so these storms now kill fewer people than they did in the past.

Meteorology—It's a Gas!, *continued*

- **Tornadoes** About 780 tornadoes touch down in the United States each year.

- Some meteorologists chase tornadoes so they can better understand how tornadoes form and how they behave.

Astronomy—Far, Far Away!

- **Astronomy** is the study of the universe.
- Astronomers use optical telescopes let astronomers see distant objects.
- Radio telescopes use radio waves to study objects that are too far away to be seen or that do not give off light.

Astronomy—Far, Far Away!, *continued*

- **Star Struck** Astronomers spend much of their time studying stars.
- Astronomers estimate that there are over 100 billion stars in the universe.
- The star that has been studied the most is the one that is closest to Earth—the sun!

Special Branches of Earth Science

- In addition to the main branches of Earth science, there are branches that rely heavily on other areas of science.
- **Environmental Science** The study of how humans interact with the environment is called *environmental science*. These scientists use geology, life science, chemistry, and physics.

Special Branches of Earth Science, *continued*

- **Ecology** The study of communities of organisms and their nonliving environment is called *ecology*.

- Ecologists work in fields such as wildlife management, agriculture, forestry, and conservation.

Special Branches of Earth Science, *continued*

- **Geochemistry** The study of the chemistry of rocks, minerals, and soil is called *geochemistry*.

- Geochemists judge the economic value of materials from the earth, determine what the environment was like when rocks formed, and study the distribution of chemicals.

Special Branches of Earth Science, *continued*

- **Geography and Cartography** People who make maps of the surface features of the Earth are called *cartographers*.

- Cities are often located by geographic features, such as rivers, that are used for transportation.

Bellringer

How can paleontologists know what a dinosaur looked like, how it behaved, and what it ate based only on its fossilized skeleton?

End Of Slide

Objectives

- **Explain** how scientists begin to learn about the natural world.

- **Explain** what scientific methods are and how scientists use them.

- **Identify** the importance of communicating the results of a scientific investigation.

- **Describe** how scientific investigations often lead to new investigations.

End of Slide

Learning about the Natural World

- How do scientists recreate what dinosaurs may have looked like? How do they start any investigation in Earth Science?

- Scientists begin to learn about the natural world by asking questions.

What Are Scientific Methods?

- **Scientific Methods** are a series of steps that scientists use to answer questions and solve problems.

- Scientists use scientific methods to gain insight into the problems they investigate.

Scientific Method

Click below to watch the Visual Concept.

Visual Concept

You may stop the video at any time by pressing the Esc key.

Ask a Question

- Asking a question helps focus the purpose of the investigation.

- When David D. Gillette, a paleontologist, examined some dinosaur fossils, he asked, "What kind of dinosaur did they come from?"

Form a Hypothesis

- A **hypothesis** is an explanation that is based on prior scientific research or observations and that can be tested.
- Based on his observations and what he already knew about dinosaurs, Gillette hypothesized that the bones came from a kind of dinosaur not yet known to scientists.

Test the Hypothesis

- A hypothesis must be tested for scientists to learn whether an idea can be supported scientifically. Scientists test hypothesis by gathering data.

- **Controlled Experiments** A *controlled experiment* is an experiment that tests only one factor, or *variable* at a time. By changing only the variable, scientists can see the results of just that one change.

Controlled Experiment and Variable

Click below to watch the Visual Concept.

Visual Concept

You may stop the video at any time by pressing the Esc key.

Test the Hypothesis, *continued*

- **Making Observations** Because scientists cannot always control all variables, some scientists often observe nature and collect large amounts of data.

- Gillette took hundreds of measurements of the dinosaur bones and compared them with those of known dinosaurs. He also visited museums and talked with other scientists.

Test the Hypothesis, *continued*

- **Keeping Accurate Records** Scientists keep clear, honest, and accurate records so their expectations do not affect their observations.

- Many example are needed to support a hypothesis. One example could prove that a hypothesis is not true.

End Of Slide

Analyze the Results

- After they finish their tests, scientists must analyze the results.
- Analyzing the results helps scientists construct reasonable explanations based on the evidence that has been collected.
- When Gillette analyzed his results, he found that the bones of the mystery dinosaur were shaped differently and were larger than the bones of any known dinosaur.

Draw Conclusions

- After analyzing the results of their tests, scientists must conclude if the results support the hypothesis.

- Proving that a hypothesis is not true can be as valuable as proving that it is true.

- Based no his studies, Gillette concluded that the bones were indeed from an unknown dinosaur. He named it *Seismosaurus hallorum*, the “earth shaker.”

End Of Slide

Communicate Results

• Scientists communicate their results to share what they have learned.

• Science depends on sharing information. Sharing allows other scientists to repeat experiments to see if they get the same results.

• By sharing, scientists can compare hypotheses. Sometimes, new data lead scientists to change their hypotheses.

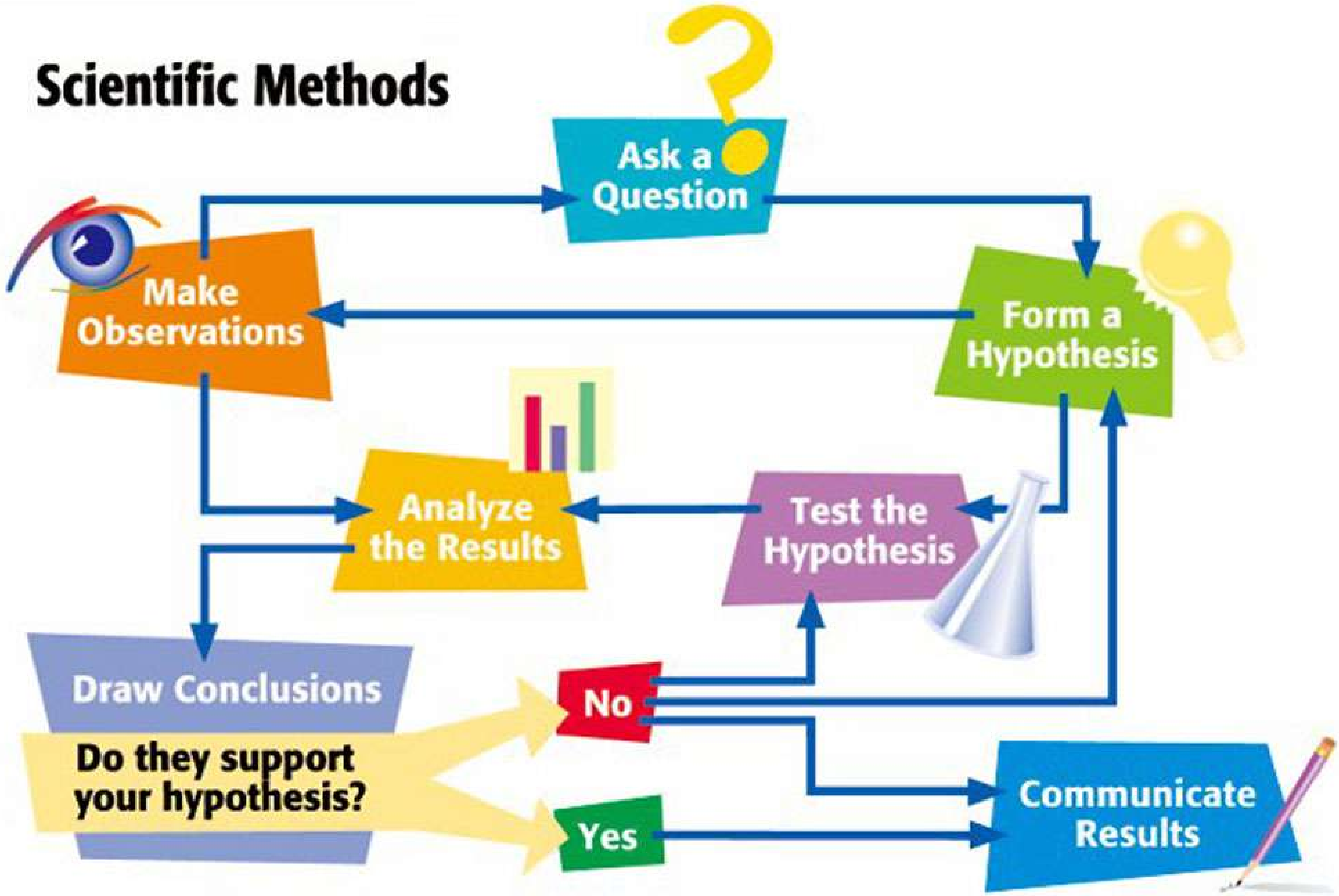
Case Closed?

- Even after results are reviewed and accepted by the scientific community, the investigation may continue. New evidence may cause the scientists to change their hypothesis.

- More questions may arise from the original evidence. What did *Seismosaurus* eat? What environment did it live in?

- Gillette continues to use scientific methods to answer these new questions.

End of Slide


Scientific Methods
Ask a Question
Make Observations
Form a Hypothesis
Analyze the Results
Test the Hypothesis
Draw Conclusions
Do they support your hypothesis?
No
Yes
Communicate Results

Bellringer

Record your responses to the following questions in your **science journal**:

How is an airplane flight simulator a kind of model?

What are some advantages to training pilots in a flight simulator rather than in a real airplane?

End Of Slide

Objectives

- **Explain** how models are used in science.
- **Describe** the three types of models.
- **Identify** which types of models are best for certain topics.
- **Describe** the climate model as an example of a mathematical model.

Types Scientific Models

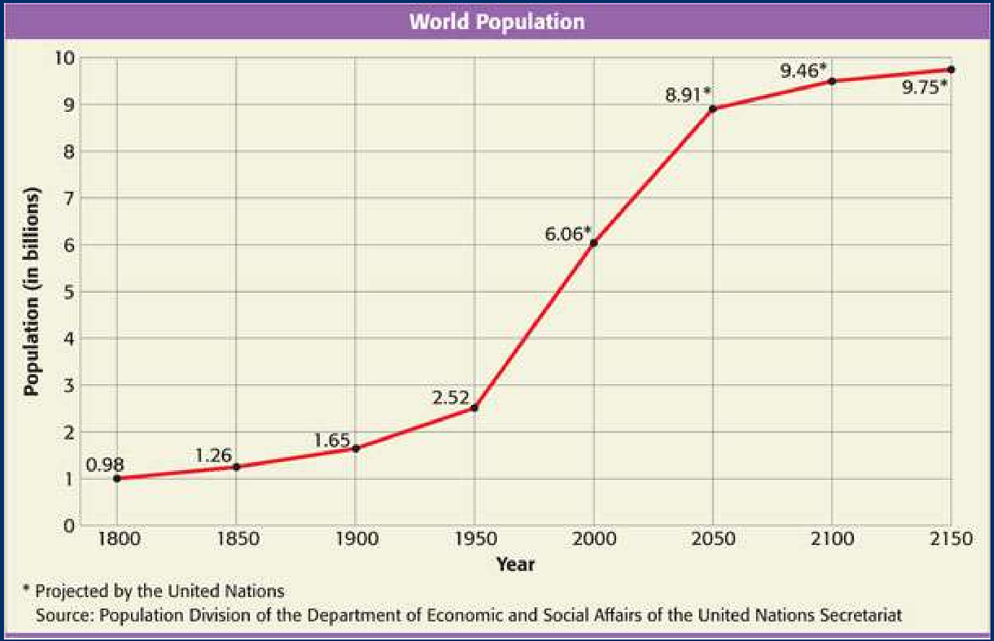
- A **model** is a pattern, plan, representation, or description designed to show the structure or working of an object, system, or concept.

- **Physical models** look like they thing they are supposed to represent. This is a physical model of a volcano.

End of Slide

Types Scientific Models, *continued*

- **Mathematical models** are made up of mathematical equations and data. Charts and graphs are examples of mathematical models.



End Of Slide

Types Scientific Models, *continued*

- The third kind of model is a **conceptual model.**
- Some conceptual models are systems of ideas.
- Other conceptual models are based on making comparisons with familiar things to help illustrate or explain an idea.

Just the Right Size

- Models are often used to represent things that are very small or very large.

- In these cases, a model can help you picture the thing in your mind.

Scientific Models

Click below to watch the Visual Concept.

Visual Concept

You may stop the video at any time by pressing the Esc key.

End Of Slide

Building Scientific Knowledge

- Models are often used to help illustrate and explain scientific theories.
- A **theory** is an explanation that ties together many hypotheses and observations.

Building Scientific Knowledge, *continued*

- **Scientific Laws** When a theory and its models correctly predict the results of many different experiments, a scientific law could be formed.

- In science, a **law** is a summary of many experimental results and observations.

- A law tells how things work.

End of Slide

Bellringer

Record your answers to the following questions in your **science journal**:

What can be measured in centimeters, meters or kilometers?

What can be measured in liters of milliliters?

What can be measured in milligrams, grams, or kilograms?

Objectives

- **Explain** the importance of the International System of Units.
- **Determine** the appropriate units to use for particular measurements.
- **Identify** lab safety symbols, and determine what they mean.

Using the International System of Units

- The **International System of Units (SI)** is the current name for the metric system. It is used by most scientists and almost all countries.

- All SI units are based on the number 10.

Common SI Units

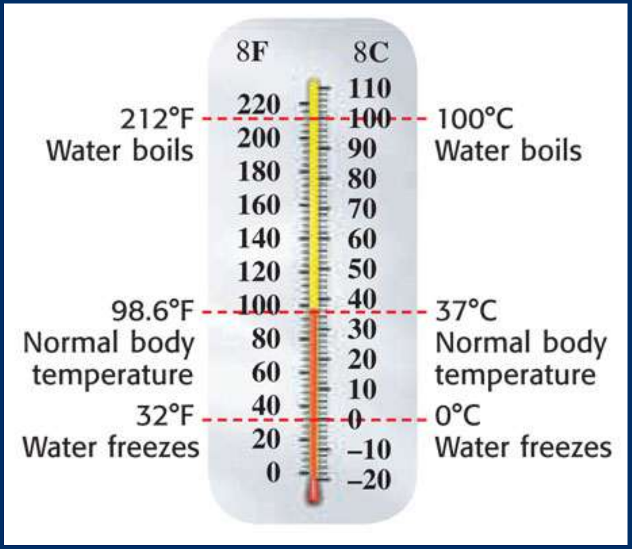
Length	**meter (m)**	
	kilometer (km)	1 km = 1,000 m
	decimeter (dm)	1 dm = 0.1 m
	centimeter (cm)	1 cm = 0.01 m
	millimeter (mm)	1 mm = 0.001 m
	micrometer (μm)	1 μm = 0.000001 m
	nanometer (nm)	1 nm = 0.000000001 m
Volume	**cubic meter (m^3)**	
	cubic centimeter (cm^3)	1 cm^3 = 0.000001 m^3
	liter (L)	1 L = 1 dm^3 = 0.001 m^3
	milliliter (mL)	1 mL = 0.001 L = 1 cm^3
Mass	**kilogram (kg)**	
	gram (g)	1 g = 0.001 kg
	milligram (mg)	1 mg = 0.000 001 kg
Temperature	**kelvin (K)**	
	Celsius (°C)	0°C = 273 K
		100°C = 373 K

Using the International System of Units, *continued*

- **Length** The basic unit of length in the SI is the meter.
- **Volume** is a measure of the size of a body or region in three-dimensional space.
- **Mass** is a measure of the amount of matter in an object. The basic unit for mass is the kilogram (kg).

Measurement, *continued*

- **Temperature** is a measure of how hot (or cold) something is.



Using the International System of Units, *continued*

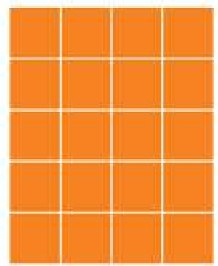
- **Area** is the measure of how much surface an object has. To calculate area of a square or a rectangle use this equation:

$$area = length \times width$$

End Of Slide

Math Focus

Finding Area What is the area of a rectangle that has a length of 4 cm and a width of 5 cm?



Step 1: Write the equation for area.

$$area = length \times width$$

Step 2: Replace the length and width with the measurements given in the problem, and solve.

$$area = 4\ \text{cm} \times 5\ \text{cm} = 20\ \text{cm}^2$$

Now It's Your Turn

1. What is the area of a square whose sides measure 5 m?
2. What is the area of a book cover that is 22 cm wide and 28 cm long?

Using the International System of Units, *continued*

- **Density** is the ratio of the mass of a substance to the volume of a substance. You can calculate density by using the following equation:

$$density = \frac{mass}{volume}$$

End Of Slide

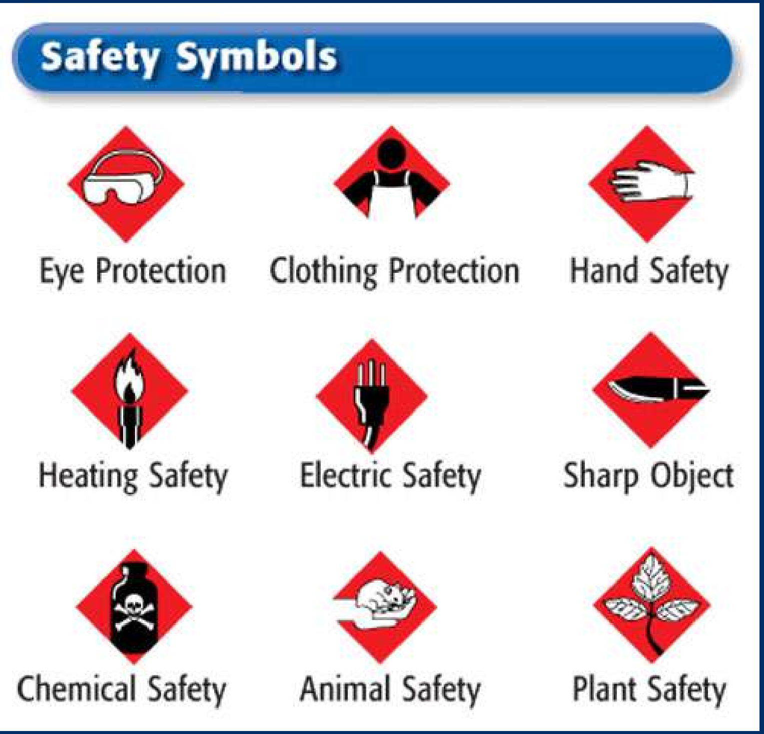
Safety Rules!

• Get your teacher’s permission before starting any science investigation.

• Read lab procedures carefully, and pay special attention to safety information.

Safety Rules!, *continued*

- Know the meaning of the following safety symbols.



- Because scientists duplicate each other's work, they must record numbers with the same degree of precision as the original data.
- **Significant Digits** are the number of digits in a measurement that you know with a certain degree of reliability.
- There are rules for determining whether digits are significant.

Lesson 2-1

Significant Digits Rules

1. All nonzero numbers are significant.
2. Zeros between nonzero digits are significant.
3. One or more final zeros used after the decimal point are significant.
4. Zeros used solely for spacing the decimal point are NOT significant. The zeros only indicate the position of the decimal point.

* The blue numbers in the examples are the significant digits.

Number	Significant Digits	Applied Rules
1.234	4	1
1.02	3	1, 2
0.023	2	1, 4

4. Zeros used solely for spacing the decimal point are NOT significant. The zeros only indicate the position of the decimal point.

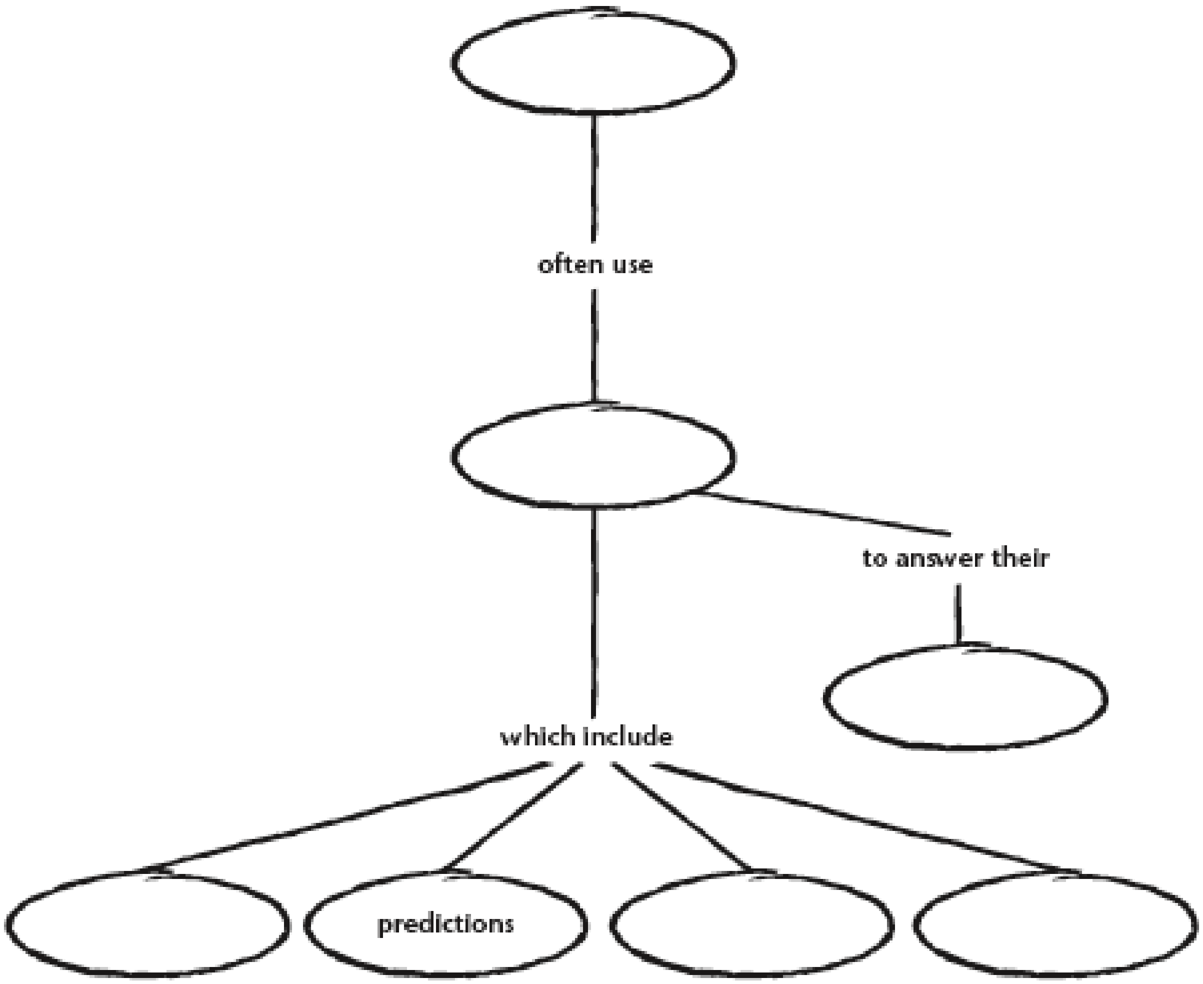
* The blue numbers in the examples are the significant digits.

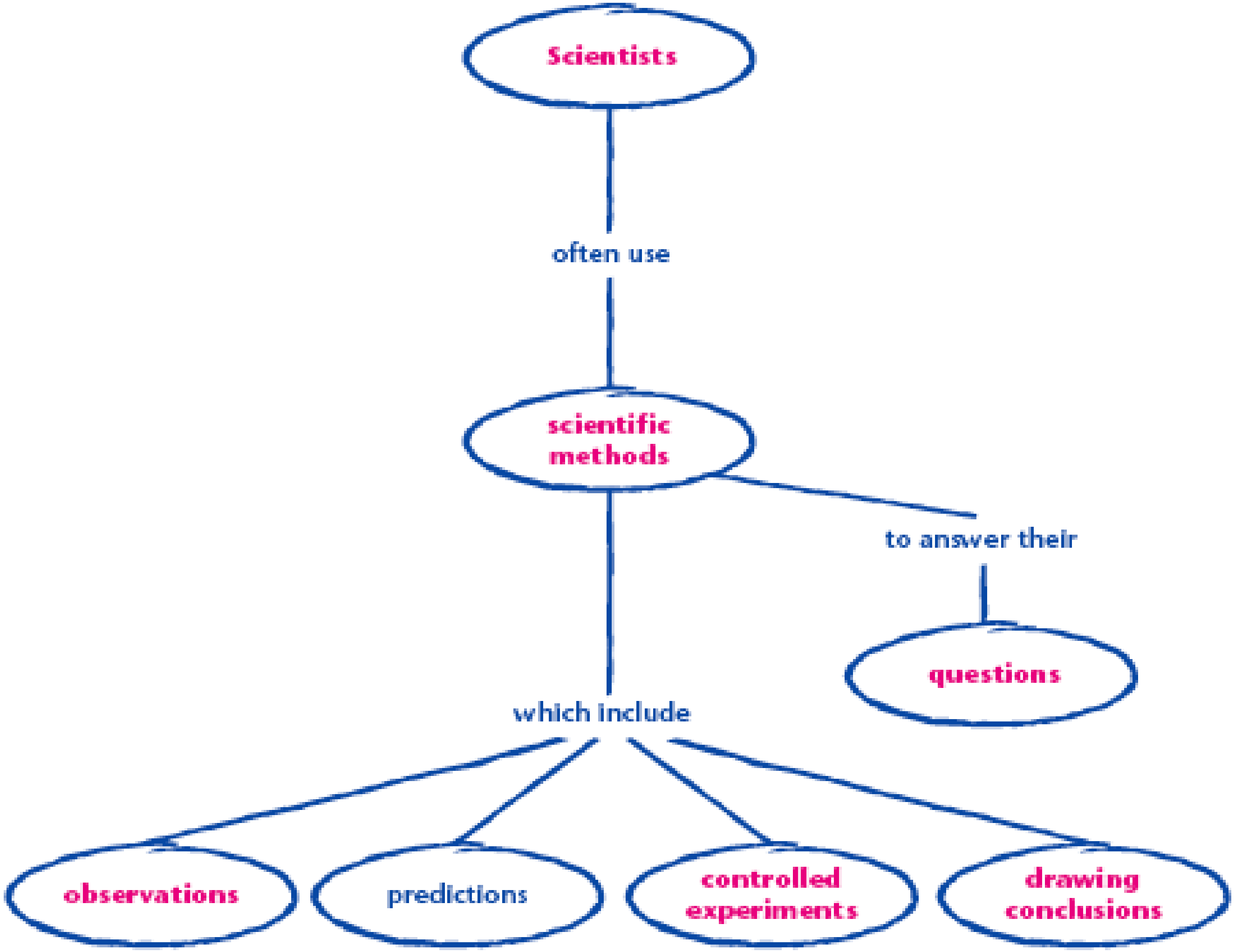
Number	Significant Digits	Applied Rules
1.234	4	1
1.02	3	1, 2
0.023	2	1, 4
0.200	3	1, 3
1,002	4	1, 2
3.07	3	1, 2
0.001	1	1, 4
0.012	2	1, 4
50,600	3	1, 2, 4

Concept Map

Use the terms below to complete the concept map on the next slide.

Scientific Methods in Earth Science
observations
controlled experiments
drawing conclusions
scientists
questions


often use
to answer their
which include
predictions


Scientists
often use
scientific methods
to answer their
questions
which include
observations
predictions
controlled experiments
drawing conclusions

End of Chapter 1 Show

End Of Slide

Reading

Read each of the passages. Then, answer the questions that follow each passage.

Passage 1 Scientists look for answers by asking questions. For instance, scientists have wondered if there is some relationship between Earth's core and Earth's magnetic field. To form their hypothesis, scientists started with what they knew: Earth has a dense, solid inner core and a molten outer core. They then created a computer model to simulate how Earth's magnetic field is generated.

Continued on the next slide

Passage 1, ***continued*** The model predicted that Earth's inner core spins in the same direction as the rest of the Earth but slightly faster than the surface. If that hypothesis is correct, it might explain how Earth's magnetic field is generated. But how could the researchers test the hypothesis? Because scientists couldn't drill down to the core, they had to get their information indirectly. They decided to track seismic waves created by earthquakes.

1. In the passage, what does *simulate* mean?

A to look or act like

B to process

C to calculate

D to predict

1. In the passage, what does *simulate* mean?

A to look or act like

B to process

C to calculate

D to predict

2. According to the passage, what do scientists wonder?

F if the Earth's inner core was molten

G if there was a relationship between Earth's core and Earth's magnetic field

H if the Earth had a solid outer core

I if computers could model the Earth's core

2. According to the passage, what do scientists wonder?

F if the Earth's inner core was molten

G if there was a relationship between Earth's core and Earth's magnetic field

H if the Earth had a solid outer core

I if computers could model the Earth's core

3. What did the model predict?

A The Earth's outer core is molten.

B The Earth's inner core is molten.

C The Earth inner core spins in the same direction as the rest of the Earth.

D The Earth's outer core spins in the same direction as the rest of the Earth.

3. What did the model predict?

A The Earth's outer core is molten.

B The Earth's inner core is molten.

C The Earth inner core spins in the same direction as the rest of the Earth.

D The Earth's outer core spins in the same direction as the rest of the Earth.

Passage 2 Scientists analyzed seismic data for a 30-year period. They knew that seismic waves traveling through the inner core along a north-south path travel faster than waves passing through it along an east-west line. Scientists searched seismic data records to see if the orientation of the "fast path" for seismic waves changed over time. They found that in the last 30 years, the direction of the "fast path" for seismic waves had indeed shifted.

Continued on the next slide

End Of Slide

Passage 2, ***continued*** This is strong evidence that Earth’s core does travel faster than the surface, and it strengthens the hypothesis that the spinning core creates Earth’s magnetic field.

1. In the passage, what does *orientation* mean?

A speed

B direction

C magnetic field

D intensity

1. In the passage, what does *orientation* mean?

A speed

B direction

C magnetic field

D intensity

2. What evidence did scientists find?

F The Earth's core does travel faster than the surface.

G The "fast path" does not change.

H Seismic waves travel faster along an east-west line.

I The spinning core does not create the Earth's magnetic field.

2. What evidence did scientists find?

F The Earth's core does travel faster than the surface.

G The "fast path" does not change.

H Seismic waves travel faster along an east-west line.

I The spinning core does not create the Earth's magnetic field.

3. What do scientists hypothesize about the Earth’s magnetic field?

A It was found in the last 30 years.

B It travels faster along a north-south path.

C It is losing its strength.

D It is created by the spinning core.

3. What do scientists hypothesize about the Earth's magnetic field?

A It was found in the last 30 years.

B It travels faster along a north-south path.

C It is losing its strength.

D It is created by the spinning core.

Interpreting Graphics

The table below contains data that shows the relationship between volume and pressure. Use the table to answer the questions that follow.

Volume (L)	Pressure (kPa)
0.5	4,960
1.0	2,480
2.0	1,240
3.0	827

1. What is the pressure when the volume is 2.0 L?

A 4,960 kPa

B 2,480 kPa

C 1,240 kPa

D 827 kPa

Volume (L)	Pressure (kPa)
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Volume (L)	Pressure (kPa)
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1.0	2,480
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3.0	827

End Of Slide

2. What is the volume when the pressure is 827 kPa?

Volume (L)	Pressure (kPa)
0.5	4,960
1.0	2,480
2.0	1,240
3.0	827

F 0.5 L

G 1.0 L

H 2.0 L

I 3.0 L

2. What is the volume when the pressure is 827 kPa?

Volume (L)	Pressure (kPa)
0.5	4,960
1.0	2,480
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F 0.5 L

G 1.0 L

H 2.0 L

I 3.0 L

3. What is the change in pressure when the volume is increased from 0.5 L to 1.0 L?

Volume (L)	Pressure (kPa)
0.5	4,960
1.0	2,480
2.0	1,240
3.0	827

A 4,960 kPa

B 2,480 kPa

C 1,240 kPa

D 0.50 kPa

3. What is the change in pressure when the volume is increased from 0.5 L to 1.0 L?

Volume (L)	Pressure (kPa)
0.5	4,960
1.0	2,480
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A 4,960 kPa

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End Of Slide

Volume (L)	Pressure (kPa)
0.5	4,960
1.0	2,480
2.0	1,240
3.0	827

4. Which of the following patterns best describes the data?

F When the volume is doubled, the pressure is tripled.

G When the volume is tripled, the pressure is cut in half.

H As the volume increases, the pressure remains the same.

I As the volume increases, the pressure decreases.

4. Which of the following patterns best describes the data?

F When the volume is doubled, the pressure is tripled.

G When the volume is tripled, the pressure is cut in half.

H As the volume increases, the pressure remains the same.

I As the volume increases, the pressure decreases.

Math

Read each question, and choose the best answer.

1. The original design for a boat shows a rectangular shape that is 5 m long and 1.5 m wide. If the design is reduced to 3.4 m long and 1 m wide, by how much does the area of the boat decrease?

A 1.7 m^2

B 4.1 m^2

C 7.5 m^2

D 9.2 m^2

1. The original design for a boat shows a rectangular shape that is 5 m long and 1.5 m wide. If the design is reduced to 3.4 m long and 1 m wide, by how much does the area of the boat decrease?

A 1.7 m^2

B 4.1 m^2

C 7.5 m^2

D 9.2 m^2

2. If *density = mass / volume*, what is the density of an object that has a mass of 50 g and a volume of 2.6 cm^3?

F 0.052 cm^3/g

G 19.2 g/cm^3

H 47.4 g/cm^3

I 130 g/cm^3

2. If *density = mass / volume*, what is the density of an object that has a mass of 50 g and a volume of 2.6 cm^3?

F 0.052 cm^3/g

G 19.2 g/cm^3

H 47.4 g/cm^3

I 130 g/cm^3

3. During a chemical change, two separate pieces of matter combined into one. The mass of the final product is 82 g. The masses of the original pieces must equal the final product's mass. What are the possible masses of the original pieces of matter?

A 2 g and 18 g

B 2 g and 41 g

C 12 g and 8 g

D 42 g and 40 g

3. During a chemical change, two separate pieces of matter combined into one. The mass of the final product is 82 g. The masses of the original pieces must equal the final product's mass. What are the possible masses of the original pieces of matter?

A 2 g and 18 g

B 2 g and 41 g

C 12 g and 8 g

D 42 g and 40 g

4. An adult *Seismosaurus hallorum* weighs 82 tons. A baby *Seismosaurus hallorum* weighs 46 tons. The weight of the baby *Seismosaurus hallorum* is what percentage of the weight of the adult *Seismosaurus hallorum*?

F 24%

G 44%

H 56%

I 98%

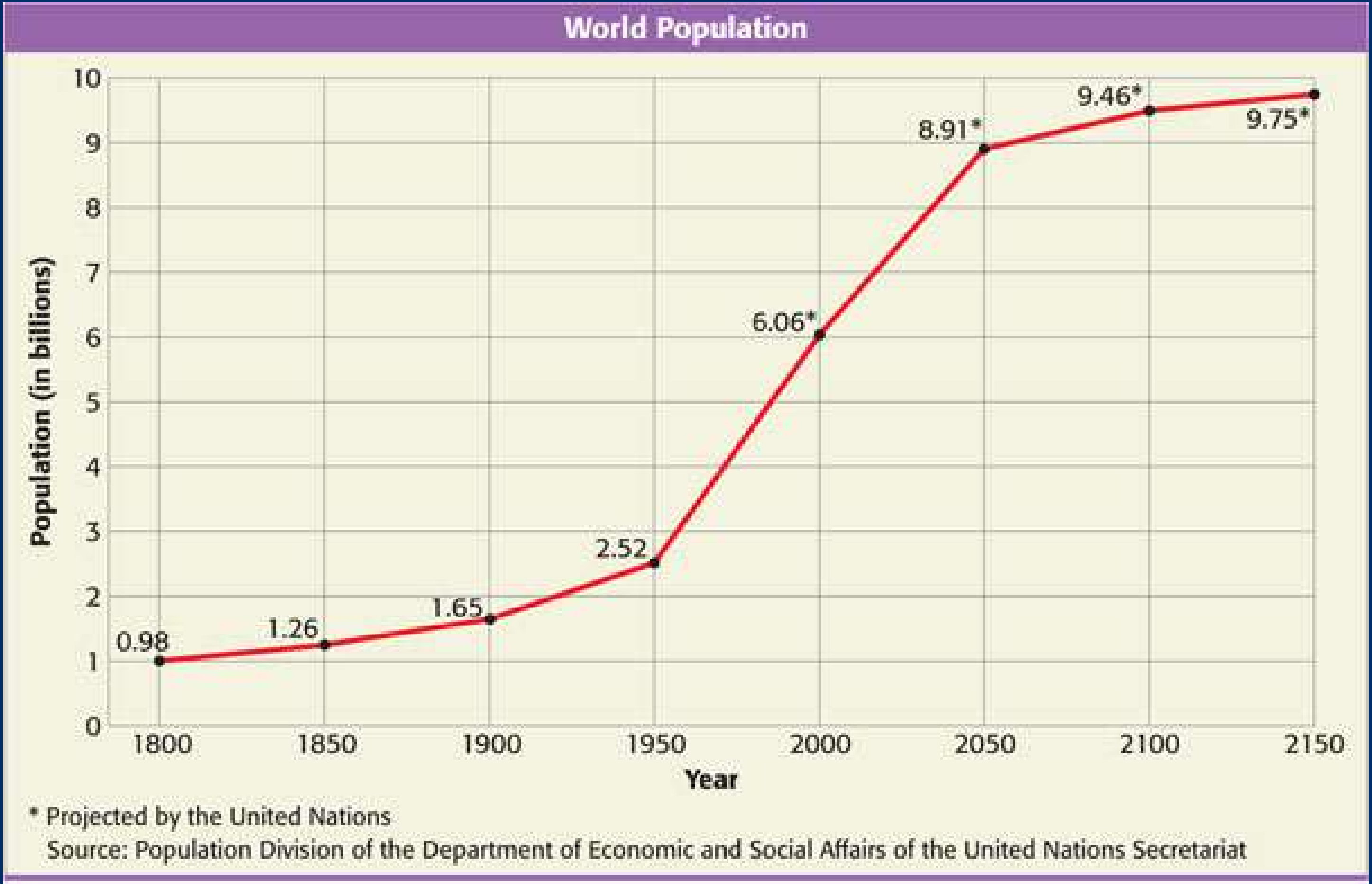
4. An adult *Seismosaurus hallorum* weighs 82 tons. A baby *Seismosaurus hallorum* weighs 46 tons. The weight of the baby *Seismosaurus hallorum* is what percentage of the weight of the adult *Seismosaurus hallorum*?

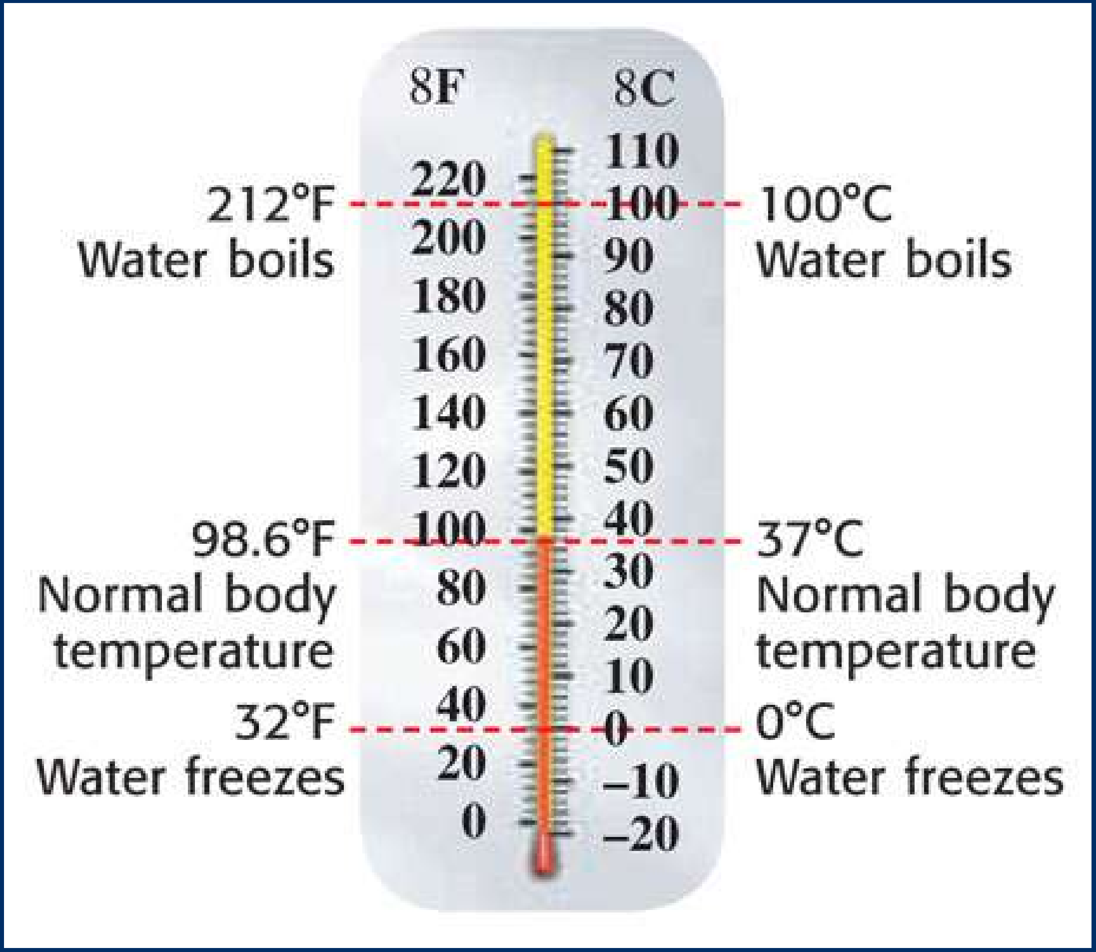
F 24%

G 44%

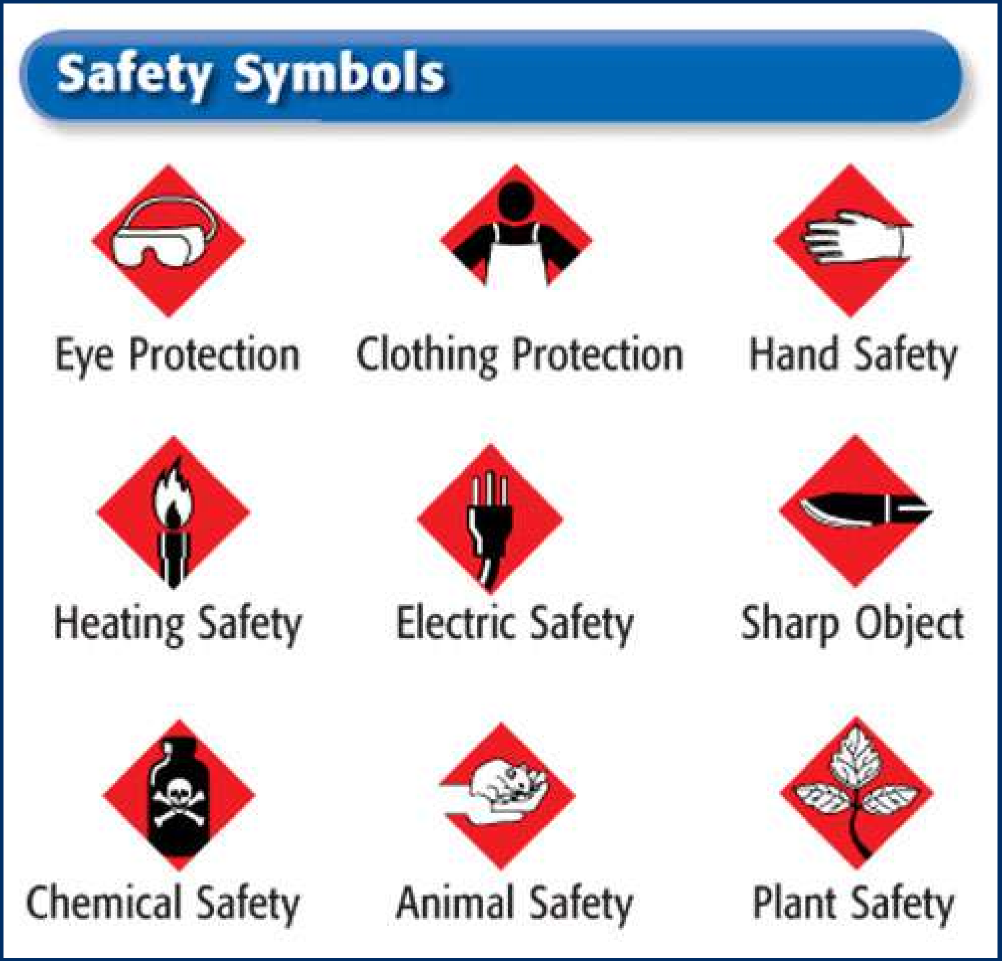
H 56%

I 98%


World Population
Population (in billions)
0
1
2
3
4
5
6
7
8
9
10
Year
1800
1850
1900
1950
2000
2050
2100
2150
0.98
1.26
1.65
2.52
6.06*
8.91*
9.46*
9.75*
* Projected by the United Nations
Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat



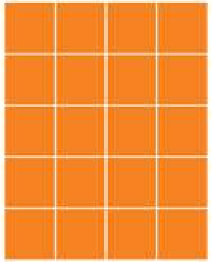
Chapter menu
Resources


Safety Symbols
Eye Protection
Clothing Protection
Hand Safety
Heating Safety
Electric Safety
Sharp Object
Chemical Safety
Animal Safety
Plant Safety

Volume (L)	Pressure (kPa)
0.5	4,960
1.0	2,480
2.0	1,240
3.0	827

MATH FOCUS

Finding Area What is the area of a rectangle that has a length of 4 cm and a width of 5 cm?



Step 1: Write the equation for area.

$$area = length \times width$$

Step 2: Replace the length and width with the measurements given in the problem, and solve.

$$area = 4\text{ cm} \times 5\text{ cm} = 20\text{ cm}^2$$

Now It's Your Turn

1. What is the area of a square whose sides measure 5 m?
2. What is the area of a book cover that is 22 cm wide and 28 cm long?